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# Engineering Note

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**Project:** Dzero Electrical Support

**Doc. No:** 1051101A

**Subject:** Support documentation for review of Muon test stand for unattended operation

## *Introduction*

On the first floor of the Dzero assembly building there exists a test stand used by the Muon group to test their electronics. Historically this test stand has always been assumed to be used only when attended by personnel. A recent service call to repair a component of that test stand showed numerous safety concerns, including comments to the effect that, in actuality, the stand is often left running unattended. In order to provide for safe operation of the test stand, the immediate safety issues were addressed and the test stand was modified by the Dzero electrical support group to allow for unattended operation. With all modifications now complete the Dzero electrical support group requests a formal review of the test stand by appropriate personnel to determine if all requirements for unattended operation have been correctly met.

## *Overall description of test stand*

The Muon test stand consists of a rack of power supplies and various support electronics connected to some free-standing boards that sit on a massive iron block as shown in Figure 1. A set of scintillators and phototubes provide some triggering signals from cosmic rays. An additional power supply is mounted on the side of the iron block as shown in Figure 2. The entire test stand is powered by a single 115VAC, 20A outlet. The total power needs of the test stand are within the limits of a single outlet.

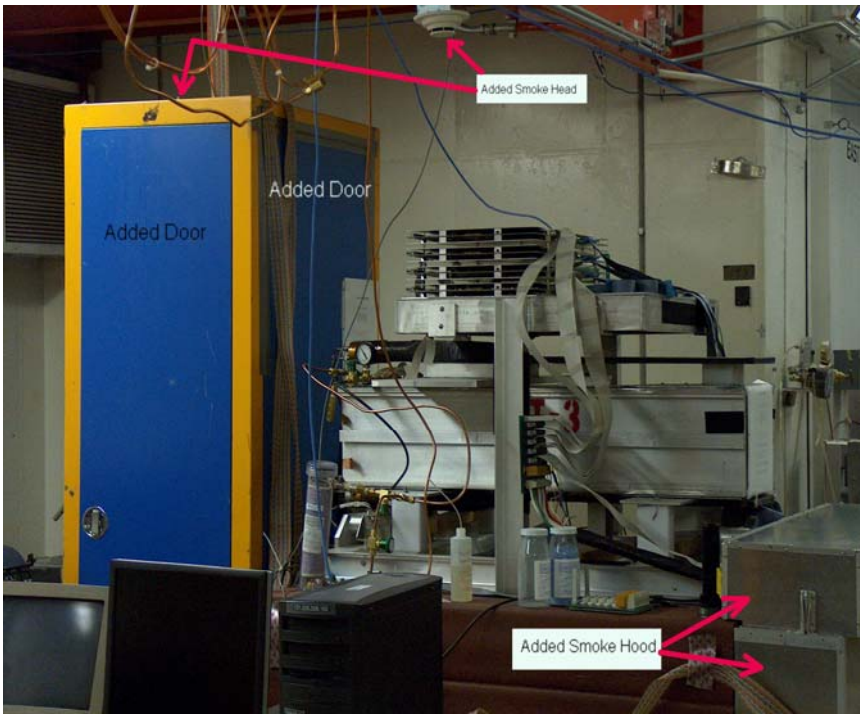


**Figure 1 – Overall picture of muon test stand on 1st floor of Dzero assembly building**

**Figure 2 – power supply mounted at end of iron block, showing 'fume hood'**

## *Operational issues addressed by the Dzero electrical support group*

- Hazard: Multiple outlet strips daisy-chained together.
    - Mitigation: outlet strips have been removed and, where necessary, longer cords have been installed. A rack-mounted set of user-switched convenience outlets have been provided for mobile test equipment. All 110VAC wiring has been brought back to a single point of control.
- Hazard: Overuse of a bench-mounted outlet strip to the point where conductors and plugs were warm to the touch
    - Mitigation: The bench-mounted strip and the computers it powers have been moved to a different circuit to split the load.
- Hazard: Network and other low-voltage cables ty-wrapped to electrical conduit; multiple trip hazards from wires on floor.
    - Mitigation: Proper hangers and/or walk-over wireways have been installed.
- Hazard: No smoke detectors anywhere and the relay rack open to air on all sides
    - Mitigation: Smoke detectors within the rack, over the iron block and over the power supply mounted at the end of the iron block have been installed. Appropriate rack doors and walls, plus a hood to capture smoke over the outboard power supply, have been installed.
- Hazard: No rack protection electronics, and no overall control circuit to kill power
    - Mitigation: The smoke detectors have been tied into a Cook Rack Monitor Interface box. The RMI controls a BiRa model 8885 solid-state relay box which interrupts all power in the test stand upon fault.

## *Power Consumption and Control*

Under normal operation the PDT power supplies in the test stand (one on the iron block, one in the relay rack) each consume no more than 200W of power. The other equipment in the rack uses up another 200-250W. Allowing another 300W of user test equipment powered from convenience outlets, the estimated draw is well within the 15A limits of a single outlet. Control of this power is accomplished through the use of one BiRa model 8885 controlled outlet box. A single cord is run to the 8885 from the wall socket. The controlled outlet of the 8885 feeds an outlet strip inside the rack. All devices within the rack, plus the externally mounted supply on the iron block and the user convenience outlets, are powered from the strip in the rack.

Control of power is exercised by a Cook RMI box that monitors the state of three smoke detectors wired in parallel. Smoke detector #1 covers the relay rack. Smoke detector #2 is an overall sensor that is mounted on the I-beam above the test setup. Smoke detector #3 is mounted inside a "fume hood" that has been constructed to capture any smoke caused by a failure of the PDT power supply mounted on the iron block. If any smoke detector is set off, the RMI kills power to the entire test stand. Tests were performed using a smoke detector test spray can to insure all detectors work.

The RMI, once tripped, stays tripped until reset. Provision has been made to connect this RMI to a Rack Monitor in the calorimeter "5K test stand" elsewhere in the 1st floor as shown in Figure 3. At present this remote monitoring capability has not been installed as it is considered sufficient to kill the power.

**Figure 3 – route of remote status indicator cable**

## *Responsible Personnel and Training Requirements*

The Dzero Muon Group headed by Al Ito is in charge of the Muon test stand. They are the sole users of the test stand. After modifications were made Mr. Ito was asked to assemble his group and they were shown the changes made and the correct operation of the Cook RMI. Responsibility for maintaining operational procedures rests with the Dzero experimental personnel.